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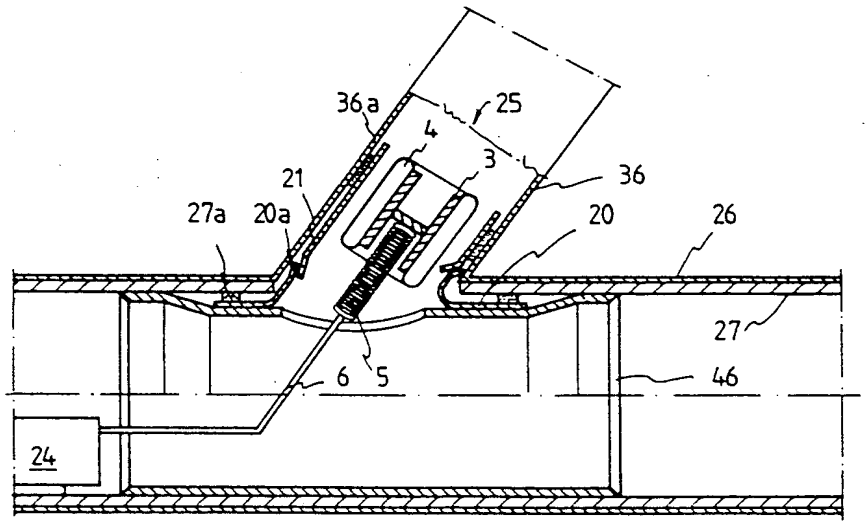
(54) Title: DEFORMATION DEVICE FOR DEFORMING A SEALING ELEMENT MADE OF PLASTICS MATERIAL FITTED IN A PIPE



(57) Abstract

Deformation device (25) for deforming a saddle fitted in a pipe (26) with branch pipe (36), said saddle comprising a saddle plate (20) and saddle branch (21) comprising a balloon (4) with an inner cylinder (35). The device (25) is carried by a flexible hose (5) which is connected at one end to a gas inlet (34) provided with a connection piece (39) and at the other end to a plunger (31) which slides so that it seals in an inner cylinder (35). When medium is admitted to an expansion chamber (7) formed between plunger (31) and a shut-off flange (17), carrier (3) with balloon (4) is moved away from the hose (5) outwards, and plunger (31) is pulled inwards again by retraction spring (8). A pressure plate (19) for pressing the saddle plate down bears releasable spring-loaded clamping elements (23) for retaining a saddle plate (20).

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Deformation device for deforming a sealing element made of plastics material fitted in a pipe.

The invention relates to a deformation device for deforming, by means of heat and pressure, a sealing element made of plastics material fitted from the inside in a pipe provided with branch pipes, for the purpose of sealing leaks and/or connections in such pipes, at least comprising a carrier which bears an inflatable balloon provided with a gas inlet and gas outlet, which carrier can be connected by means of a carrier element to an arm, rotatable and displaceable in various directions, of a remote-controllable carriage which can be conveyed inside the pipe.

Such a known deformation device is used for renovating or repairing existing pipes provided with branch pipes, in order to reseal damaged parts without removing said existing pipe with any branch pipes present.

The latter applies in particular to the renovation and repair of pipe systems lying in the ground, more particularly sewer pipes.

For the repair, a saddle with saddle branch made of thermoplastic plastic, for example, is fitted in such pipes with branch pipes, whereafter the saddle branch is pressed by means of a heated inflatable balloon against the inside wall of the branch pipe and the saddle plate is pressed so that it seals against the inside of the pipe or of a plastics lining pipe provided in such a pipe.

This known deformation device, in which the carrier with balloon is rigidly fixed to the arm of a remote-controllable carriage, has the disadvantage that the arm has to be accurately placed at the correct angle relative to the main pipe in order to be able to place the balloon correctly and inflate it in the saddle branch of the connecting part. It is difficult to determine the connection angle of the branch pipes accurately, particu-

larly in the case of connection angles of approximately 45°, and a slight bend can also be present in the branch pipe just near the connection to the main pipe, or other unforeseeable situations can also occur.

It is therefore clear that the rigid fixing of the carrier with balloon to the robot arm is very disadvantageous.

Another disadvantage is that it is not readily possible with the existing device to obtain a good connection of the saddle plate to the inside of the pipe if there are slight deviations in the diameter of the saddle plate and the internal diameter of the main pipe or its lining. With the combination of deviations of diameters and of connection angles in particular, it is not easy to work with the existing device.

The object of the invention is now to provide a deformation device of the above-mentioned type which does no longer present these disadvantages.

This object is achieved through the fact that the carrier element is made flexible.

The flexible design means that the carrier with inflatable balloon can always be placed in the branch pipe without difficulty, without problems being encountered due to a slight deviation of the connection angle or a slight bend or the like in the branch pipe just near the connection.

Yet another disadvantage of the known device is that, on account of the limited radial dimensions of the saddle with branch -even if it is made in two parts - and of the balloon, which have to be maintained on in order to be able to convey the saddle and balloon with carrier and deformation device through the pipe by means of a remote-controllable carriage, only a saddle with short branch can be inserted, and said branch can deform over only a short length.

In order to overcome this, it is particularly advantageous to fix the carrier with balloon so that they are axially movable relative to the carrier element.

By applying this measure it is possible to convey

a balloon with loose saddle branch placed thereon inside the pipe and then to insert it in the branch pipe. It is then also possible with a balloon of limited length in a branch pipe at an angle of, for example, 45° to inflate the branch over an adequate length by using the balloon in two positions displaced axially relative to each other.

For the axial displacement of carrier with balloon relative to the carrier element, it is advantageous to make use of expansion means, while retraction means are present for moving carrier and carrier element axially towards each other again, in order to be able to return the deformation device to its original position.

The carrier element advantageously comprises a flexible hose provided with a medium inlet, which hose opens out into an expansion chamber expanding through medium pressure, by means of which, on the one hand, a flexible connection between carrier element and carrier with balloon is achieved while, on the other hand, the carrier with balloon is easy to displace axially relative to the carrier element in the lengthwise direction.

Expansion limiting means are expediently present in order to limit the axial movement of the carrier with balloon relative to the carrier element, preferably a stop, while on the other hand the retraction means advantageously comprise a tension spring.

When a saddle plate used as a sealing element is being placed and pressed down in a pipe, if there are deviations in the internal diameter of the main pipe, it is often difficult to obtain a good connection of the saddle plate on the inside of the pipe.

However, this is achieved advantageously according to the invention through the fact that the device is also provided with a pressure element which can interact with a sealing element to be deformed in a pipe, preferably a saddle plate with a saddle branch extending into a branch pipe, which pressure element expediently can exert a uniform pressure all the way round.

For this purpose, it is particularly advantageous

to provide the pressure element with an elastic pressure element part, preferably a hollow ring of elastic material filled with a medium.

According to a particularly advantageous embodiment, the pressure element is provided with one or more mechanically releasable, preferably spring-loaded, clamping elements for retaining a sealing element, in particular a saddle plate with saddle branch, which clamping elements lose their spring-loaded action when the pressure element acts on a sealing element.

Use of the elastic pressure element is also possible in the case of a device without flexible carrier element.

With the aid of a device according to the invention it is possible in particular to fit a two-part saddle in a pipe with branch pipe in such a way that simultaneously the saddle plate of the saddle can be pressed down in a well-fitting manner and the branch of the saddle can also be inserted in a flexible manner and widened, while the angle between saddle and branch does not have to be determined entirely accurately in advance.

The invention will now be explained on the basis of a number of examples of embodiments with reference to the drawing, in which:

Fig. 1 shows schematically a pipe with a branch pipe, with in the pipe a remote-controllable carriage bearing on an arm a deformation device according to the invention, a part of which is shown;

Fig. 2 shows the same pipe with branch pipe as that shown in Fig. 1, in which a fixing element is used for fixing the saddle plate, with a part of a deformation device according to the invention;

Fig. 3 shows a deformation device according to the invention in cross-section;

Fig. 4 shows a variant of a deformation device with carrier element according to the invention;

Figs. 5 and 5a show a detail of a saddle with a pressure element for pressing in a saddle plate; and

Fig. 6 shows a detail of a saddle plate with

saddle branch held on a pressure element.

Fig. 1 shows a pipe 26 provided with a plastics lining pipe 27 fitted from the inside, with a bore at the position of a branch pipe 36.

A remote-controllable carriage 24 is situated in the inside of the pipe 26, said carriage being provided with an arm 6 which is rotatable and movable in various directions, and which is connected to a deformation device 25 according to the invention. The arm 6 is coupled to a flexible hose 5 of deformation device 25 with inflatable balloon 4, to be described later.

For obtaining a good seal in such a pipe with branch pipe, use is made of a saddle which is in two parts, comprising a saddle plate 20 with saddle branch 21 extending into the branch pipe. The saddle plate 20 also bears a projecting saddle plate part 20a extending into the branch pipe 36 (for this, see also Fig. 4 in particular).

For the formation of a good seal, the saddle branch 21 must be pressed down against a branch pipe liner 37 provided in a branch pipe, or against the inside wall of the branch pipe 36. Seal 27a is pressed firmly between saddle plate 20 and lining pipe 27.

Fig. 2 shows another variant, in which for the fixing of the saddle plate 20 use is made of a cylindrical fixing element 46 which is expanded by means of a deformation device according to the invention, forming a good tight connection between fixing element 46 and lining pipe 27 and saddle plate 20. A seal 36a is present between the saddle branch 21 and the inside wall of branch pipe 36.

Fig. 3 shows a deformation device according to the invention, comprising a rigid carrier 3, on which an inflatable balloon 4 is fixed. This balloon 4 is formed from a cylindrical part 13 of an elastic material, from which balloon parts 16, 16a are turned back at both ends. These balloon parts 16, 16a are glued to the outside wall parts 14, 15 of the carrier 3. Other methods of fixing are, of course, also possible.

For heating of the sealing element to be fitted in a pipe, such as a saddle plate or saddle branch or protective branch pipe liner 31, the balloon wall is provided with heating element 30.

In order to limit the maximum expansion in diameter of the balloon 4, the balloon 4 is expediently surrounded by a flexible reinforcement sleeve 12, for example of woven polyester, lying between balloon wall 13 and heating element 30.

In order to be able to guide the deformation device through the inside of a pipe, the total effective length of the inflatable balloon 4 and of saddle branch 21 are limited. This also means that in a branch pipe 36 only the sealing element, such as a saddle branch 21 or a branch pipe liner 37, can be deformed over a limited length.

In practice, it may, however, be desirable to make the deformation take place over a greater length.

For this, the deformation device according to the invention is provided with a carrier arm 5 of flexible material in the form of a flexible plastics hose. One end of the hose 5 is fixed to a plunger 31 which can slide in a rigid cylinder 35, a seal 32 being present between the outside of plunger 31 and cylinder 35. At the other end flexible hose 5 is fixed to a connection piece 39 provided with a gas inlet 34. A tension spring 8 is fitted between the inside end 40 of connection piece 39 and a fixed fixing part 41. When a gaseous pressure medium is admitted through gas inlet 34, a pressure will be built up in the chamber 7 between fixing part 41 and plunger 31, so that the cylinder 35 and fixing part 41 are moved outwards relative to hose 5, possibly until stop 1 is reached.

Connection piece 39 can be coupled to an arm 6 of carriage 24.

After this, the pressure in expansion chamber 7 is lowered, so that as a result of the retraction means in the form of retraction spring 8, cylinder 35 returns to its original position. In order to maintain a certain

pressure force between plunger 31 and connection 39 and to prevent extension of the hose 5 during the axial movement of the carrier 3 with balloon 4 relative to the flexible hose, an axially flexible, cylindrical retaining element 10 is preferably present. Said element can be in the form of a closed tension spring, and can also serve to reinforce the rigidity of hose 5, in order thus to obtain the correct ratio between rigidity and flexibility, and also in order to limit any radial expansion of hose 5 which may be present.

It will be clear that through use of the flexible hose 5, it is easy to introduce the deformation device 25 into a branch pipe 36, irrespective of the angle present between branch pipe 36 and main pipe 26. The deformation device 25 is provided on the underside with a shut-off flange 28 between carrier 3 and cylinder 35. A shut-off flange 17 is also present on the upper side. A blow-through opening 18 with its own medium supply, for example air, can be present in this shut-off flange 17, in order to be able to blow the branch pipe clean before the balloon 4 is inflated.

In order to provide for rapid cooling down of the balloon, which is provided with a gas inlet 52 and outlet 53, an excess pressure valve 11 can be present in the gas outlet, through which a gas under pressure can be conveyed through the balloon, so that it cools down rapidly. The flange 17 is fixed by means of a bolt 38 to top fixing part 41.

Fig. 4 shows how a saddle is placed.

Saddle plate 20 is held fast on pressure plate 19, the loose saddle branch 21 by a slightly inflated balloon 4. The whole device is fixed to a robot and introduced into a pipe at the correct place, guided by, for example, a TV camera which is not shown. Saddle plate 20 is pressed against the inside wall of the pipe 1, and saddle branch 21 is introduced into it by extending the deformation device by means of excess pressure in chamber 7 after the branch pipe (not shown) is blown clean. As a result of the angle between branch pipe 36 and main pipe

26, the flexible carrier element 5 in this case assumes the curved position shown. After heating of the branch 21 with heating element 30, balloon 4 is inflated further to press the heated branch 21 against the inside wall of a branch pipe 36. Simultaneously with the deformation of the branch 21, the part 20a of saddle plate 20 projecting inside the branch pipe is also expanded. If the length of the branch 21 is too great for it all to be heated and inflated in one go with the projecting saddle plate part 20a, the part of the branch 21 projecting furthest into the branch pipe is inflated first. Deformation device 25 is then retracted by retraction spring 8 following lowering of the pressure in expansion chamber 7. The deformation of branch 21 and saddle plate part 20a can then take place.

Figures 5 and 5a show how the saddle plate 20 is pressed against the inside wall of the pipe 26 by means of a curved annular pressure element 19 interacting with the deformation device.

In order to be able to absorb variations in the diameter of the pipe relative to the diameter of the saddle plate, the pressure element 19 can exert a uniform pressure, which is achieved through said pressure element 19 having an elastic pressure element part 22. Said elastic pressure element part 22 is preferably a hollow, medium-filled ring of deformable material with an originally oval cross-section.

When there are differences in diameters, the pressure element part 22 adapts to them, while uniform pressure occurs everywhere owing to the filling with preferably a fluid.

Releasable spring-loaded clamping elements 23 are used for retaining the saddle 20 with saddle branch part 21 on the pressure plate 19.

Fig. 6 shows the different stages of the spring-loaded element 23. Reference number 23 indicates that the saddle plate 20 is held on the pressure plate 19, 23' indicates that on approaching the inside wall of the pipe 27 the releasable clamping element 23 is already moving

away from the saddle plate end 20a, and 23" indicates the shape of the releasable spring-loaded element 23 after it has been fully released from the saddle plate 20.

As can be seen, the releasable spring-loaded clamping elements 23 are secured on pressure plate 19 by means of a screw 33.

Claims

1. Deformation device for deforming, by means of heat and pressure, a sealing element (20, 21) made of plastics material fitted from the inside in a pipe (26) provided with at least one branch pipe (36), for the purpose of sealing leaks and/or connections in such pipes, at least comprising a carrier (3) which bears an inflatable balloon (4) provided with a gas inlet and gas outlet, which carrier can be connected by means of a carrier element (5) to an arm (6), rotatable and displaceable in various directions, of a remote-controllable carriage (24) which can be conveyed inside the pipe (26), characterised in that the carrier element (5) is made flexible.

2. Device according to claim 1, characterised in that the carrier (3) with balloon (4) is fixed so that it can move axially relative to the carrier element (5).

3. Device according to claim 1 or 2, characterised in that the device is provided with expansion means (7) for moving carrier (3) with balloon (4) and carrier element (5) axially apart relative to each other.

4. Device according to one or more of claims 1 - 3, characterised in that the device is provided with retraction means (8) for moving carrier (3) and carrier element (5) axially inwards relative to each other.

5. Device according to one or more of the preceding claims, characterised in that the device is provided with retraction means (8) for moving carrier (3) with balloon (4) and carrier element (5) axially apart relative to each other, which retraction means comprise a tension spring (11).

6. Device according to one or more of the preceding claims, characterised in that the carrier element comprises a flexible hose (5) provided with a medium inlet (34), which hose opens out in an expansion chamber (7) which is expandable through medium pressure.

7. Device according to claim 5, characterised in

that expansion limiting means (1) are present for limiting the axial movement of the carrier (3) with balloon (4) relative to the carrier element (5).

8. Device according to one or more of claims 1 - 6, characterised in that the flexible hose (5) in the form of a carrier element is surrounded by an axially flexible cylindrical retaining element (10).

9. Device according to one or more of claims 1 - 7, characterised in that the balloon (4) is provided with a cooling element for accelerated cooling.

10. Device according to one or more of claims 1 - 8, characterised in that the device is provided with a cooling element, which cooling element comprises an excess pressure valve (11) for blowing a cooling gas through the inside of the balloon (4).

11. Device according to one or more of claims 1 - 10, characterised in that the balloon (4) is surrounded by a flexible reinforcement sleeve (12) which limits the expansion of the balloon (4) in radial direction.

12. Device according to one or more of claims 1 - 11, characterised in that the balloon (4) is formed from a cylindrical part (13) of elastic material, from which cylindrical part (13) balloon parts (16, 16a) are turned inwards at both ends, which balloon parts (16, 16a) are stuck to outside wall parts (14; 15) of the rigid carrier (3).

13. Device according to one or more of claims 1 - 12, characterised in that the closed top side (17) of the rigid carrier (3) is provided with at least one blow-through opening (18), for blowing a branch line clean with fluid.

14. Device according to one or more of claims 1 - 13, characterised in that the device is also provided with a pressure element (19) which interacts with a sealing element to be deformed in a pipe or branch pipe, preferably a saddle plate (20) of a saddle with a saddle branch (21) extending into a branch pipe.

15. Device according to claim 13, characterised in that the device is provided with a pressure element (19)

which can exert a uniform pressure everywhere.

16. Device according to claim 13 or 14, characterised in that the device is provided with a pressure element (19) comprising an elastic pressure element part (22), preferably a hollow medium-filled ring of deformable material with an originally oval cross-section.

17. Device according to one or more of claims 13 - 15, characterised in that the device is provided with a pressure element (19) which is provided with one or more mechanically releasable clamping elements (23) for retaining a sealing element to be fixed in a pipe, preferably a saddle (20) with branch (21).

18. Device according to claim 17, characterised in that the clamping elements (23) lose their effect when the pressure element (19) acts.

19. Device according to claim 17 or 18, characterised in that the mechanically releasable clamping elements (23) are spring-loaded elements.

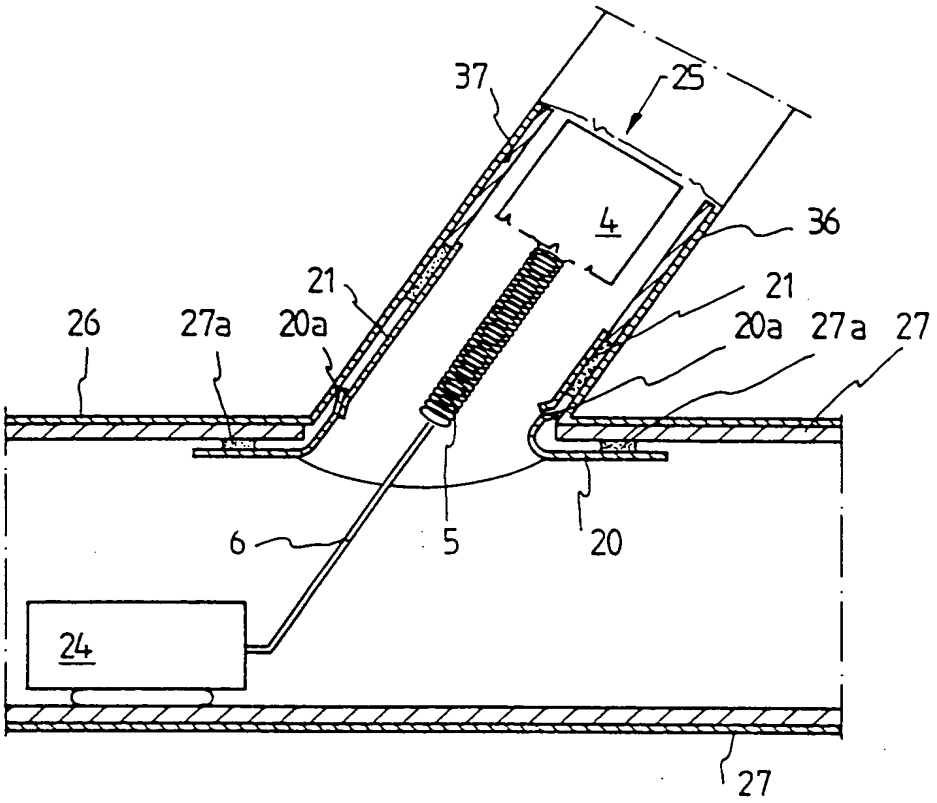
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Fig: 1

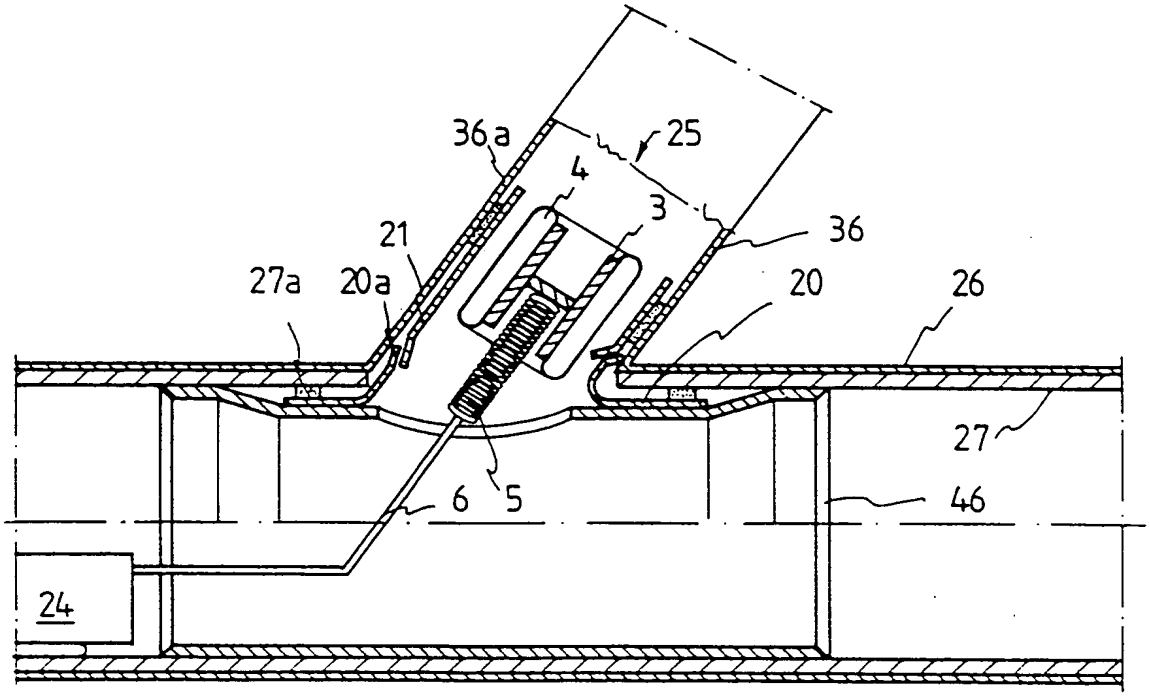
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Fig: 2

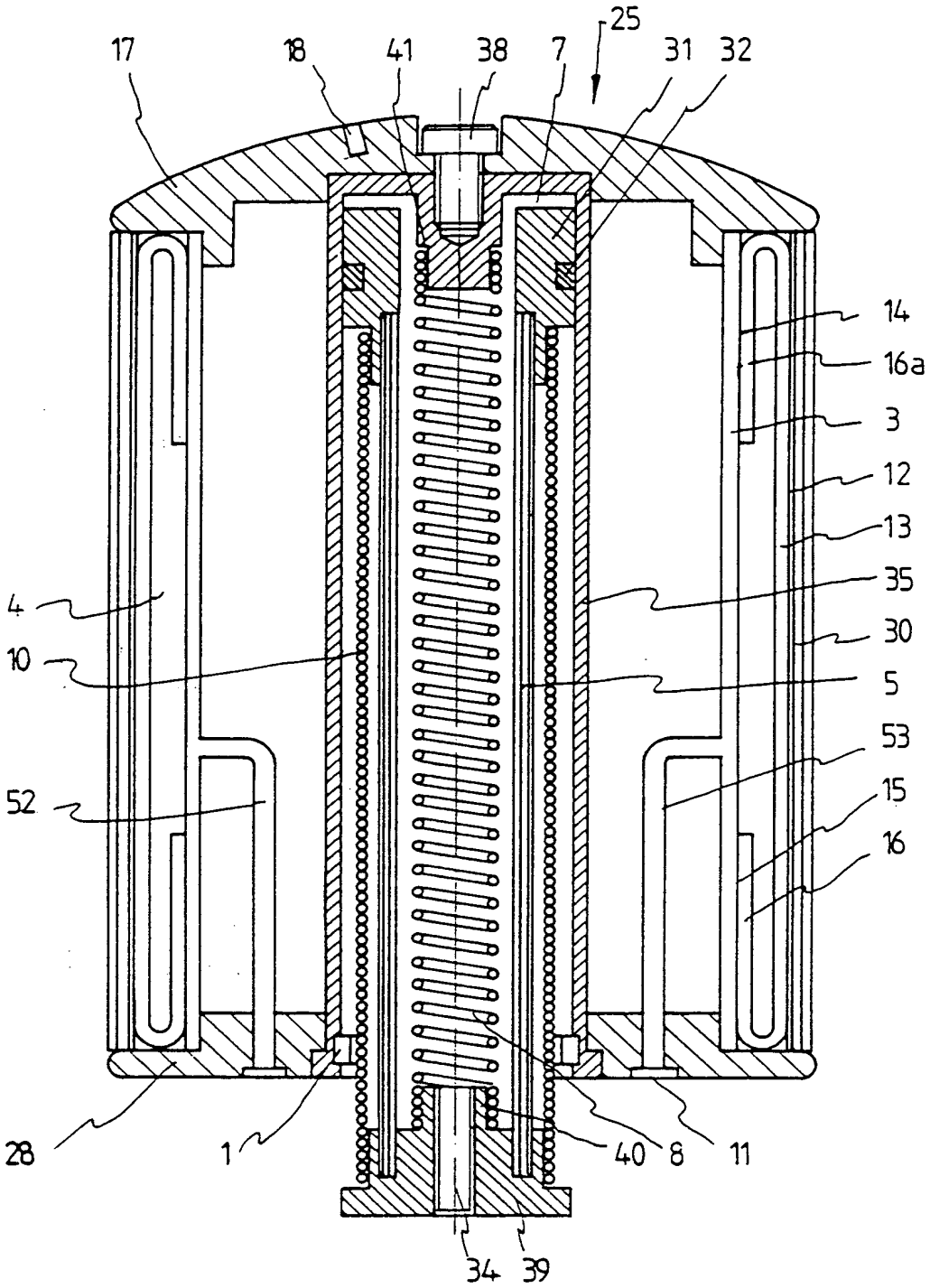
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Fig. 3

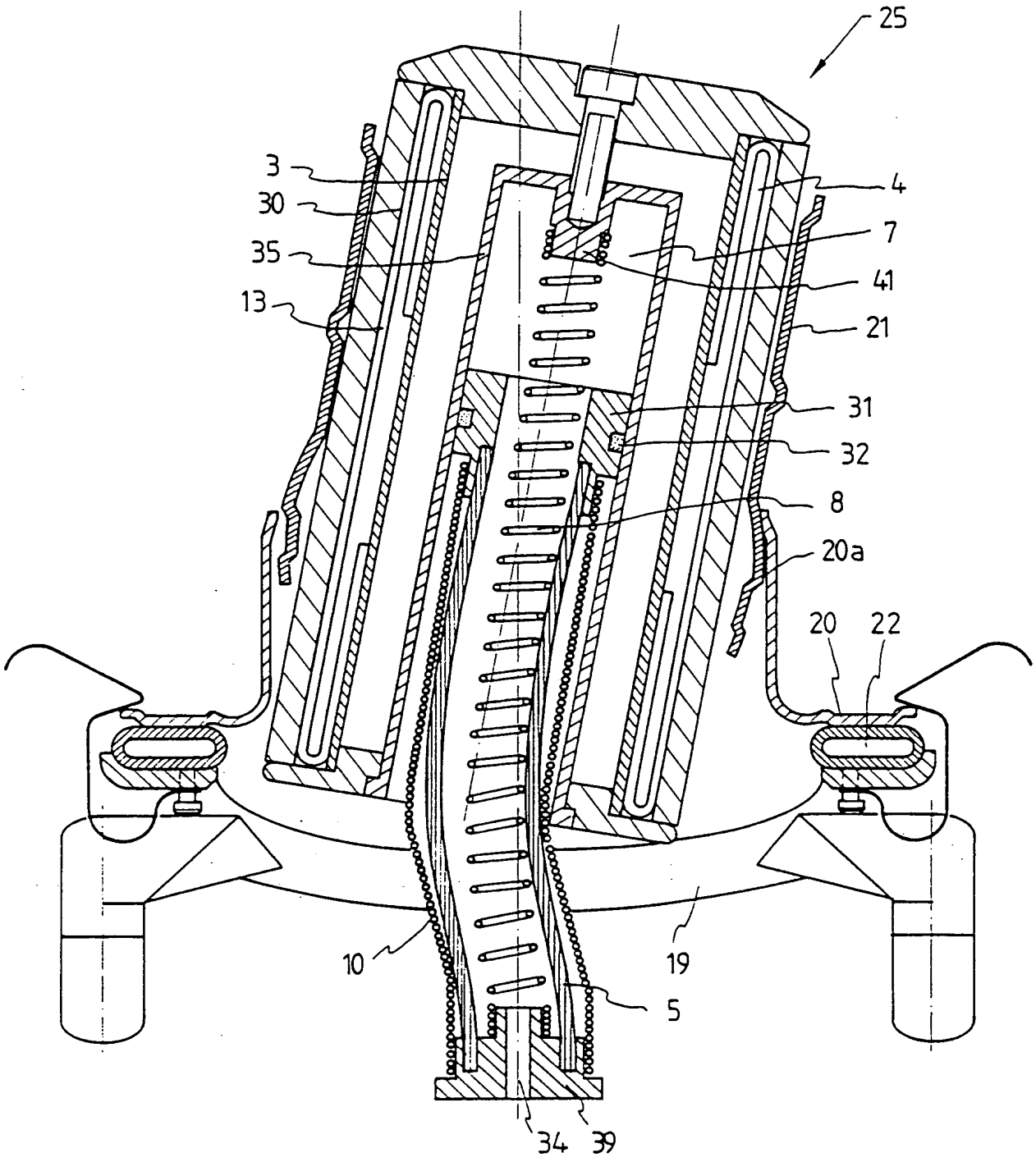

Fig. 4

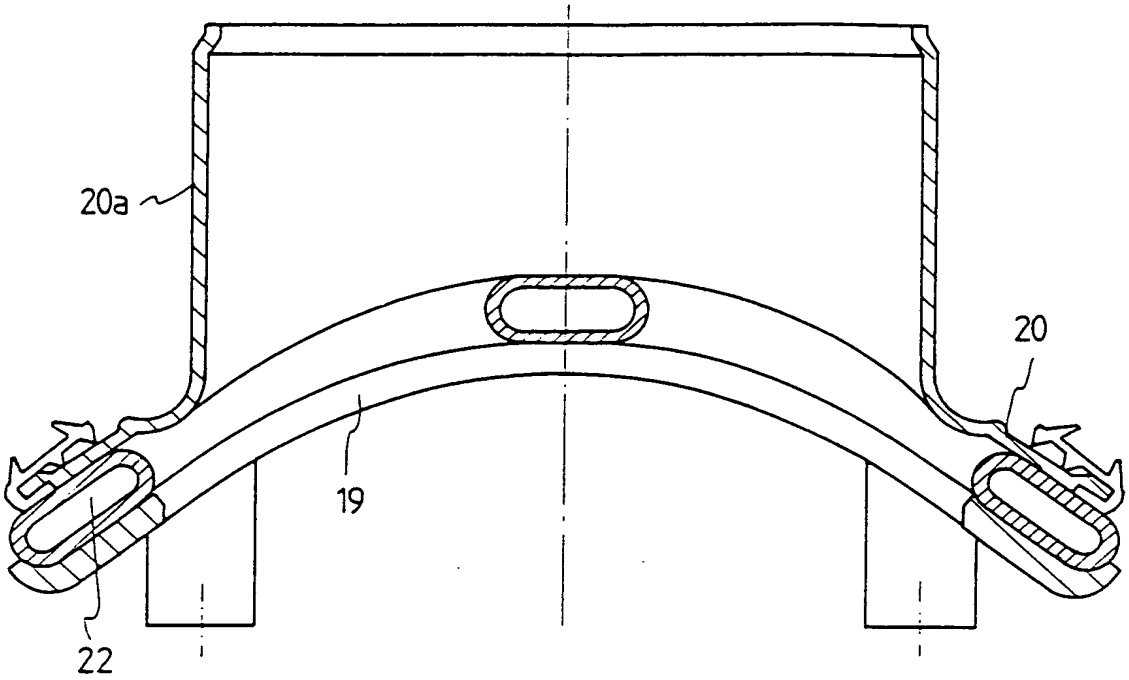

Fig: 5

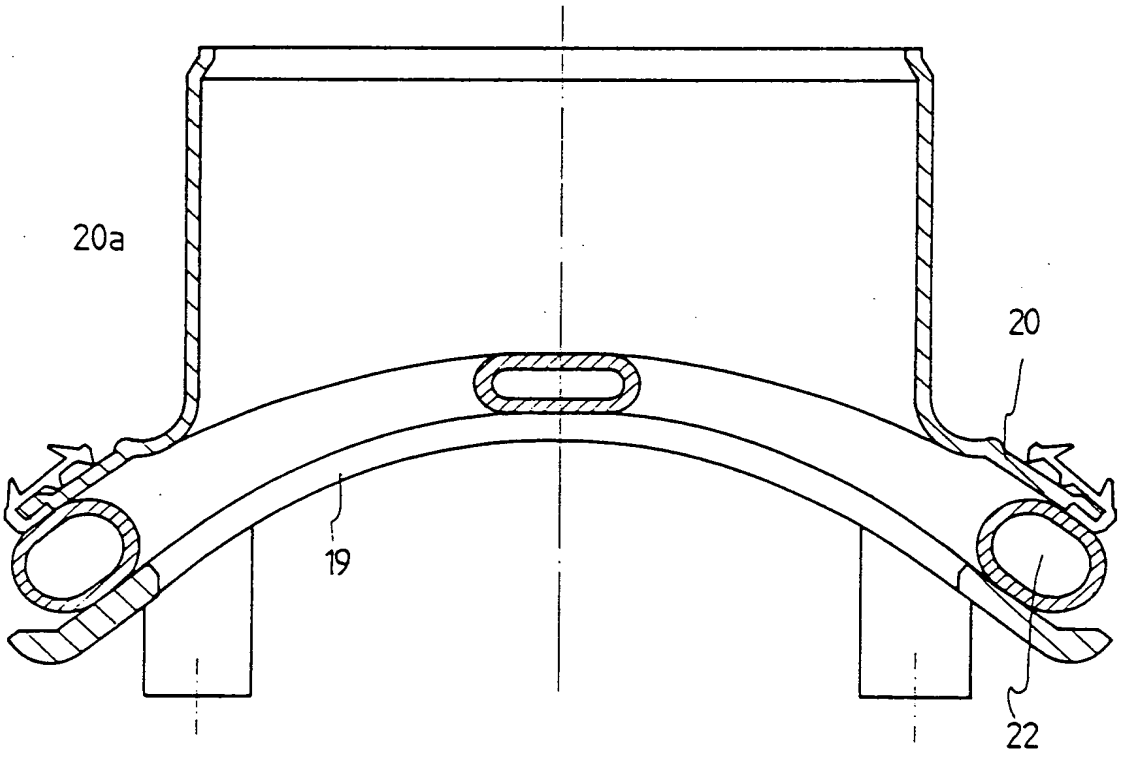

Fig: 5a

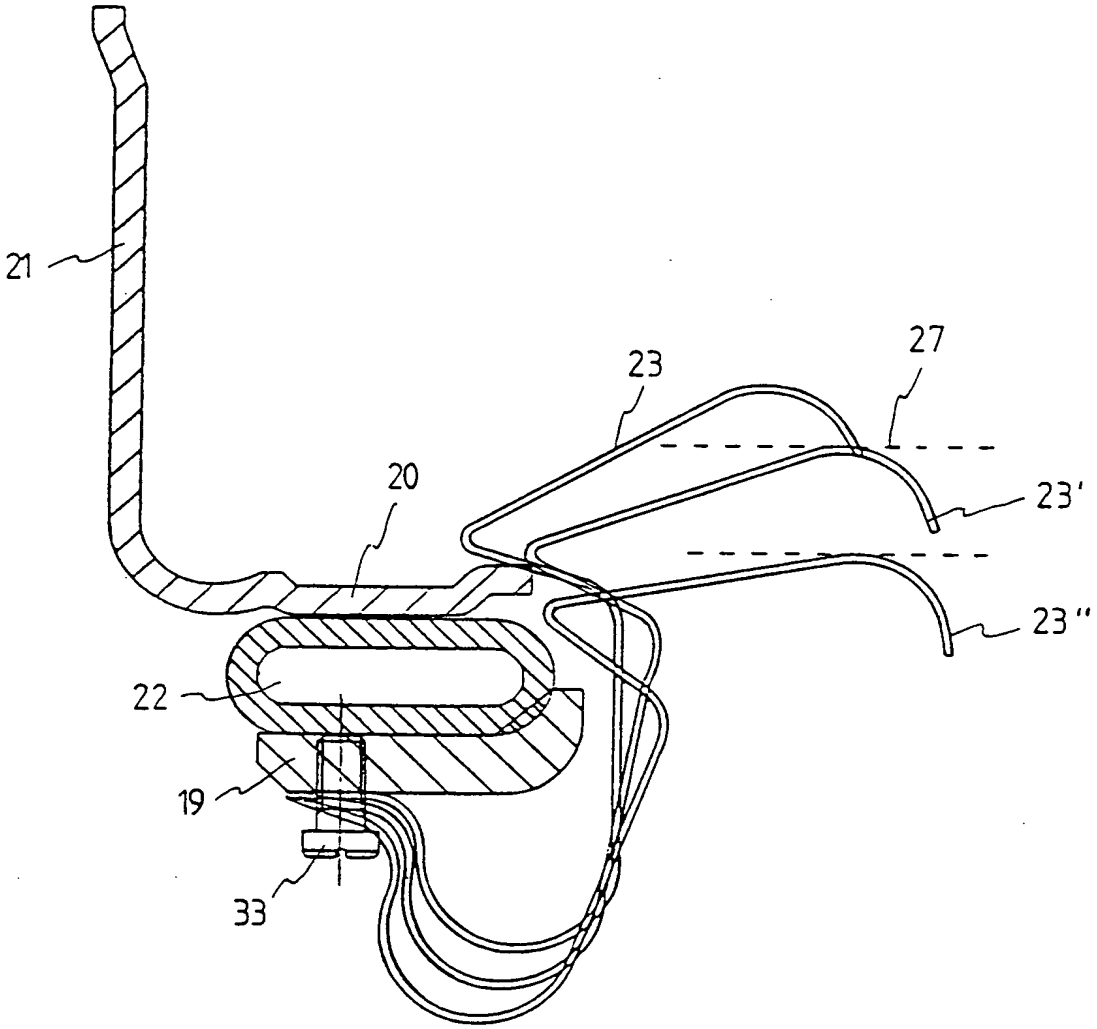

Fig:6

INTERNATIONAL SEARCH REPORT

International Application No PCT/NL 92/00087

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 F16L55/16; F16L55/18; E03F3/06

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	F16L ; E03F

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No.[13]
Y A	WO,A,9 005 874 (HIMMLER) 31 May 1990 see page 5, line 31 - page 6, line 26; figures 2,3	1 6
Y	DE,A,3 602 281 (ZAWISLA) 30 July 1987 see column 4, line 9 - line 22; figure 4	1
A	EP,A,0 253 588 (TRACEY) 20 January 1988 see column 10, line 25 - column 11, line 8; figure 2	1,6

° Special categories of cited documents : [10]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
03 SEPTEMBER 1992	11. 09. 92
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	HUBEAU M.G.

Form PCT/ISA/210 (second sheet) (January 1985)

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. NL 9200087 SA 60391

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on
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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
WO-A-9005874	31-05-90	CH-A-	676495	31-01-91
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